Appendices

APPENDIX A:
NATIONAL PARK UNITS WITH FOSSIL RESOURCES

More than sixty national parks and monuments in the United States contain fossils. In some cases these are outstanding fossil resources of major importance. In all cases, they are protected resources that are available for public educational use. The fossils of National Park Service units are valuable resources for expanding the horizons of students of all ages and they should not be overlooked.

National parks and monuments with fossils are found in all parts of the country, although some areas, such as the West, have a higher concentration. The following list is a summary of those parks known to have fossil resources. Some of the facilities that would be useful for instructional use are also given in abbreviated form following the address. This information was obtained by a survey of the parks and was current as of April 1993. The abbreviations are as follows:

SG	facilities well suited for school groups
RC	park representative available to talk to a class
PS	paleontologist on park staff
RP	research being done on paleontological resources in park
MD	museum displays of fossils
PL	fossil preparation laboratory
TC	teaching or research collection (not on display)
HO	hands-on fossil exhibit
NW	interpretive nature walk
FW	interpretive walk emphasizing fossils
IP	fossils visible in place in outcrop
PC	publications available that could be useful in classroom
NF	facilities not especially suited for paleontology
'	fossils **rare**

ALASKA

Aniakchak National Monument & Preserve
PO Box 7
King Salmon AK 99613
Bering Land Bridge National Preserve
PO Box 220
Nome AK 99762 (RC RP TC IP)

Cape Krusenstern National Monument
PO Box 1029
Kotzebue AK 99752

Katmai National Park and Preserve
PO Box 7
King Salmon AK 99613 (SG RC RP TC NW FW IP)

Kobuk Valley National Park
PO Box 1029
Kotzebue AK 99752

Noatak National Preserve
PO Box 1029
Kotzebue AK 99752

Wrangell - St Elias National Park and Preserve
PO Box 29
Glenallen AK 99588 (IP)

Yukon - Charley Rivers National Preserve
PO Box 167
Eagle AK 99738-0167 (SG RC RP MD TC I P)

ARIZONA

Glen Canyon National Recreation Area
PO Box 1507
Page AZ 86040

Grand Canyon National Park
PO Box 129
Grand Canyon AZ 86023 (MD RC NW FP IP)

Petrified Forest National Park
PO Box 217
Petrified Forest National Park AZ 86028-0217
(SG RC RP MD TC HO NW FW IP PC)

Walnut Canyon National Monument
Walnut Canyon Road
Flagstaff AZ 86004-9705 (SG NW)

Wupatki National Monument
HC 33
Box 444 A
Flagstaff AZ 86004

ARKANSAS
Buffalo National River
PO Box 1173
Harrison AR 72601 (SG MD TC NW IP)
CALIFORNIA
Channel Islands National Park
1901 Spinaker Drive
Ventura CA 93001
(SG RC MD TC HO NW FW IP PC)

Death Valley National Monument
Death Valley CA 92328

Point Reyes National Seashore
Point Reyes CA 94956 (SG MD HO IP)
Redwood National Park
1111 Second Street
Crescent City CA 95531

Santa Monica Mountains National Recreation Area
22900 Ventura Boulevard
Suite 140
Woodland Hills CA 91364

Sequoia National Park
Three Rivers CA 93271

COLORADO
Bent's Old Fort National Historic Site
35110 Highway 194 East
La Junta CO 81050-9523 (NF)

Black Canyon of the Gunnison National Monument-
PO Box 1648
Montrose CO 81402 (SG RC NW)

Colorado National Monument
Fruita CO 81521-9530 (SG MD TC NW PC)
Dinosaur National Monument
Dinosaur Quarry .
PO Box 128
Jensen UT 84035 (SG RC PS RP MD PL.IP PC)
Florissant Fossil Beds National Monument
PO Box 185
Florissant CO 80816
(SG PC PS RP MD TC HC NW FW IP PC)
Mesa Verde National Park
Mesa Verde National Park CO 81330

GUAM
War in the Pacific National Historical Park
PO Box FA
Agana GU 96910
HAWAII
Haleakala National Park
PO Box 369
Makawao HI 96768-0369 (SG RC MD NW)

IDAHO

Hagerman Fossil Beds National Monument
963 Blue Lakes Boulevard
Suite 1
Twin Falls ID 83301
KENTUCKY

Mammoth Cave National Park
Mammoth Cave KY 42259

MONTANA

Bighorn Canyon National Recreation Area
PO Box 458
Ft Smith MT 59035

Glacier National Park
West Glacier MT 59936
NEBRASKA

Agate Fossil Beds National Monument
PO Box 427
Gering NE 69341
(SG RC RP MD HO NW FW IP PC)

Scotts Bluff National Monument
PO Box 427
Gering NE 69341
NEVADA

Great Basin National Park
Baker NV 89311 (SG PR MD NW IP)
Lake Mead National Recreation Area
601 Nevada Highway
Boulder City NV 89005-2426

NEW JERSEY
Delaware Water Gap National Recreation Area
Bushkill PA 18324 (SG MD TC HO NW FW IP PC)
NEW MEXICO

Carlsbad Caverns National Park
PO Box 1598
Carlsbad NM 88220

Chaco Culture National Historical Park
Star Route 4 Box 6500
Bloomfield NM 87413 (SG RC HO IP)

Salinas National Monument
PO Box 496
Mountainair NM 87036

NORTH DAKOTA

Theodore Roosevelt National Park
PO Box 7
Medora ND 58645 (RC MD NW FW IP)

OREGON

Crater Lake National Park
PO Box 7
Crater Lake OR 79604 (MD NW PC ')
John Day Fossil Beds National Monument
420 West Main Street
John Day OR 97845
(RC PS RP MD PL TC HO NW FW IP PC)

PENNSYLVANIA

Delaware Water Gap National Recreation Area
Bushkill PA 18324 (SG MD TC HO NW FW IP PC)

Valley Forge National Historical Park
PO Box 953
Valley Forge PA 19481-0953 (NF)

SOUTH DAKOTA

Badlands National Park
PO Box 6
Interior SD 57750 (RC MD TC HO NW FW IP PC)

Wind Cave National Park
Hot Springs SD 57747

TEXAS
Big Bend National Park
Big Bend National Park TX 79834
Guadalupe Mountains National Park
HC 60 Box 400
Salt Flat TX 79847-9400
(SG RC RP MD PL TC HO NW FW IP PC)

Padre Island National Seashore
9405 S Padre Island Drive
Corpus Christi TX 78418-5597

UTAH

Arches National Park
PO Box 907
Moab UT 84532 (SG RC MD NW)

Bryce Canyon National Park
Bryce Canyon UT 84717
(SG RC RP MD TC HO NW)

Canyonlands National Park
125 West 200 South
Moab UT 84532

Capitol Reef National Park
Torrey UT 84775
Cedar Breaks National Monument
PO Box 749
Cedar City UT 84720 (SG RC MD NW)

Dinosaur National Monument
Dinosaur Quarry
PO Box 128
Jensen UT 84035 (SG RC PS RP MD PL IP PC)

Natural Bridges National Monument
PO Box 1
Lake Powell UT 84533 (SG RC MD NW ')

Timpanogos Cave National Monument
RR 3 Box 22
American Fork UT 84003
(SG RC PS RP MD NW FW IP)

Zion National Park
Springdale UT 84767-1099

VIRGINIA

Colonial National Historical Park
PO Box 210
Yorktown VA 23690

George Washington Birthplace National Monument
RR 1 Box 717
Washington's Birthplace VA 22443 (SG RC HO)

Petersburg National Battlefield
PO Box 549
Petersburg VA 23804-0949(NF)

WASHINGTON

Olympic National Park
600 East Park Avenue
Port Angeles WA 98362

WEST VIRGINIA

New River Gorge National River
PO Box 1189
Oak Hill WV 25901

WYOMING

Devils Tower National Monument
Devils Tower WY 82714 (SG MD NW)

Fossil Butte National Monument
PO Box 592
Kemmerer WY 83101
(SG RC PS RP MD PL TC HO NW FW PC)

Grand Teton National Park
PO Drawer 170
Moose WY 83012 (MD NW)

Yellowstone National Park
PO Box 168
Yellowstone National Park WY 82190
(SG RC IP RP NW FW)

APPENDIX B:
BUREAU OF LAND MANAGEMENT
STATE OFFICES AND INTERPRETED PALEONTOLOGICAL SITES

STATE OFFICES

Alaska
Anchorage Federal Office Building
222 West 7th Avenue #13
Anchorage AK 99513-7599
(907)271-5960

Arizona
3707 North 7th Street
PO Box 16563
Phoenix AZ 85011
(602)650-0200

California
Federal Building
2800 Cottage Way Room E 2841
Sacramento CA 95825-1889
(916)978-4746

Colorado
2850 Youngfield Street
Lakewood CO 80215
(303)239-3600

Idaho
3380 Americana Terrace
Boise ID 83706
(208)384-3000

Montana - North Dakota - South Dakota
Granite Tower
222 North 32nd Street
PO Box 36800
Billings MT 59107
(406)255-2885

Nevada
Federal Building Room 3123
850 Harvard Way
PO Box 12000
Reno NV 89520-0006
(702)785-6500

New Mexico - Oklahoma - Texas - Kansas
1474 Rodeo Road
PO Box 27115
Santa Fe NM 87502-0115
(505)438-7400

Oregon - Washington
1300 NE 44th Avenue
PO Box 2965
Portland OR 97208-2965
(503)280-7001

Utah
324 South State Street Suite 301
PO Box 45155
Salt Lake City UT 84145-0155
(801)539-4001

Wyoming - Nebraska
2515 Warren Avenue
PO Box 1828
Cheyenne WY 82003-1828
(307)775-6256

All other states
Eastern States Office
7450 Boston Boulevard
Springfield VA 22153-3121
(703)440-1600

INTERPRETED PALEONTOLOGICAL SITES
ON **PUBLIC LANDS**

Note: Collecting *vertebrate* fossils on lands administered by the BLM requires a permit issued by the appropriate BLM State Office. Visitors may collect reasonable quantities of common *invertebrate* fossils and petrified wood for their personal use (fossils may not be sold, bartered, or traded) on public lands unless otherwise posted. No *fossil collecting is* allowed in the special areas listed below, so that all visitors may enjoy seeing the fossils.

COLORADO

• Dinosaur Hill I Riggs Hill • Stewart Valley Paleontological Area
• Rabbit Valley Trail Through Time Mineral County Museum, Hawthorne, has exhibits of
These sites in the Grand Junction-Fruita area feature Miocene land mammals, plants, and fish from this
interpretive trails through the Jurassic dinosaurbone- area. Interpretive signs are posted on gravel roads
bearing Morrison Formation. Contact BLM District through Stewart Valley. Contact BLM Carson City
Office or Museum of Western Colorado (both in Grand District Office for more information.
Junction) for more information.

NEVADA

OREGON

• Garden Park Fossil Area • Fossil Lake
Historic and modern dinosaur quarries in the Jurassic Interpretive signs are posted at the two major
Morrison Formation near Canon City. Garden Park entrances to this area near Christmas Valley, which
Paleontological Society and Denver Museum of was covered by a Pleistocene fresh-water lake that
Natural History do research and provide tours and attracted millions of birds and other animals. Contact
information. Contact BLM District Office, Canon City, BLM Lakeview Resource Area Office for more
for more information. information.
• Picketwire Tracksite UTAH
Hundreds, of dinosaur tracks in the Jurassic Morrison • **Cleveland-Lloyd Dinosaur Quarry**
Formation near the Purgatoire River can be visited This site in the Jurassic Morrison Formation south of
during dry weather. Tours are given on Saturdays and Price has produced thousands of bones of Allosaurus.
by appointment. Contact BLM District Office, Canon It features an interpretive center, outbuildings housing
City, for more information. exhibits of dinosaur bones in the ground, and a self
guided trail. Contact BLM District Office or CEU
• Kremmling Cretaceous Ammonite Locality Prehistoric Museum (both in Price) for more
Fossil ammonites (nautilus-like shellfish) in the Pierre information.
Shale, difficult to access. Contact BLM Kremmling
Resource Area Office for more information or to • Moab Dinosaur Tracks
schedule a visit. Several kinds of carnivorous dinosaurs left their tracks
in the early Jurassic Kayenta Formation near Moab.

IDAHO Auto tours pamphlet available at the Moab Visitor
• Sand Point Fossil Area Center describes the area; BLM Moab District Office
Pliocene sediments of the Idaho Group near Hammett has information and a fossil display.
contain fossil snails and document the development of
a huge lake that once covered much of southwest • Mill Canyon Dinosaur Trail
Idaho. Contact BLM in Boise for more information. Self-guiding trail leads visitors to exposed and
preserved dinosaur bones in the Jurassic Morrison
• Maim Gulch Formation north of Moab. Interpretive brochure
Several horizons in the Eocene Challis Volcanics available from BLM Moab District Office.
contain fossil stumps, trunks, leaves, and fruits of
hardwoods, pines, and dawn redwoods. Contact the
BLM Salmon District Office before visiting the site.

APPENDIX C:
STATE GEOLOGICAL SURVEYS

Geological Survey of Alabama
PO Box O
Tuscaloosa AL 35486-9780
(205)349-2852

Alaska Division of Geological and Geophysical Surveys
3700 Airport Way
Fairbanks AK 99709
(907)451-8760

Arizona Geological Survey
845 North Park Avenue
Tucson AZ 85719
(602)621-7906

Afnsas Geological Commission
Vardelle Parham Geology Center
3815 West Roosevelt Road
Little Rock AR 72204
(501)371-1488 or 663-9714

Resources Agency
Department of Conservation
Division of Mines and Geology
1416 Ninth Street Room 1341
Sacramento CA 95814
(916)445-1923

Colorado Geological Survey
Department of Natural Resources
715 State Centennial
1313 Sherman Street
Denver CO 80203
(303)866-2611

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State Geological and Natural History Survey
Natural Resources Center
Department of Environmental Protection
165 Capitol Avenue
Hartford CT 06106
(203)566-3540

Delaware Geological Survey
University of Delaware
Newark DE 19716
(302)451-2833

Florida Geological Survey
BU(elffU of Geology
Florida Department of Natural Resources
903 West Tennessee Street
Tallahassee FL 32304-7795
((04)488-4191

Georgia Geologic Survey
Branch of Environmental Protection Division
Georgia Department of Natural Resources
Room 400
19 Martin Luther King Jr Drive SW
Atlanta GA 30334
(404)656-3214

Division of Land Development
Department of Land and Natural Resources
PO Box 373
Honolulu HI 96809
(808)548-7533

Idaho Geological Survey
University of Idaho
Moscow ID 83843
(208)885-7991

Illinois State Geological Survey
Department of Energy and Natural Resources
Natural Resources Building
615 East Peabody Drive
Champaign IL 61820
(217)333-4747

Indiana Geological Survey
Division, Indiana Department of Natural Resources
611 North Walnut Grove
Bloomington IN 47405
(812)335-9350

Geological Survey Bureau
Iowa Department of Natural Resources
123 North Capitol Street

Iowa City IA 52242
(319)335-1575

Kansas Geological Survey
The University of Kansas
1930 Constant Avenue
West Campus
Lawrence KS 66046-2598
(913)864-3965

Kentucky Geological Survey
University of Kentucky
228 Mining and Mineral Resources Building
Lexington KY 40506-0107
(606)257-5500

Louisiana Geological Survey
Department of Natural Resources
PO Box G
University Station
Baton Rouge LA 70893
(504)388-5320

Maine Geological Survey
Maine Department of Conservation
State House Station 22
Augusta ME 04333
(207)289-2801

Maryland Geological Survey
Department of Natural Resources
2300 St Paul Street
Baltimore MD 21218
(301)554-5500

Executive Office of Environmental Affairs
100 Cambridge Street
20th Floor
Boston MA 02202
(617)727-9800

Michigan Geological Survey
Department of Natural Resources
PO Box 30028
735 E Hazel Street
Lansing MI 48909

Minnesota Geological Survey
School of Earth Sciences
University of Minnesota
2642 University Avenue
St Paul MN 55114-1057
(612)627-4780

Bureau of Geology
Mississippi Department of Natural Resources
PO Box 5348
Jackson MS 39218
(601)354-6228

Division of Geology and Land Survey
Missouri Department of Natural Resources
111 Fairgrounds Road
Buehler Park
Rolla MO 65401
(314)364-1752

Montana Bureau of Mines and Geology
Montana College of Mineral Science and Technology
West Park Street
Butte MT 59701
(406)496-4181

Conservation and Survey Division
Institute of Agriculture and Natural Resources
University of Nebraska-Lincoln
113 Nebraska Hall
Lincoln NE 68588-0517
(402)472-3471

Nevada Bureau of Mines and Geology
University of Nevada-Reno
Reno NV 89557-0088
(702)784-6691

Office of the State Geologist
University of New Hampshire
117 James Hall
Durham NH 03824
(603)862-3160

New Jersey Geological Survey Element
Water Resources Division
Department of Environmental Protection
Box CN-029
Trenton NJ 08625
(609)292-1185

New Mexico Bureau of Mines and Mineral Resources
Division of New Mexico Institute of Mining and Technology
Campus Station
Socorro NM 87801
(505)835-5420

New York State Geological Survey
New York State Museum
State Education Department
Cultural Education Center
Albany NY 12230
(518)474-5816

Geological Survey Section
Division of Land Resources
North Carolina Department of Natural Resources and Community Development
PO Box 27687
Raleigh NC 27611
(919)733-3833

North Dakota Geological Survey
University Station
Grand Forks ND 58202-8156
(701)777-2231

Division of Geological Survey
Ohio Department of Natural Resources
Fountain Square
Building B
Columbus OH 43224
(614)265-6605

Oklahoma Geological Survey
University of Oklahoma
Board of Regents
830 Van Vleet Oval
Room 163
Norman OK 73019
(405)325-3031

Oregon Department of Geology and Mineral Industries
910 State Office Building
1400 SW Fifth Avenue
Portland OR 97201
(503)229-5580

Bureau of Topographic and Geological Survey
Department of Environmental Resources
PO Box 2357
Harrisburg PA 17120
(717)787-2169

Office of the State Geologist
Department of Geology
The University of Rhode Island
Kingston RI 02881
(401)792-2265/2184

South Carolina Geological Survey
South Carolina State Budget and Control Board
Division of Research and Statistical Services
5 Geology Road
Columbia SC 29210
(803)737-9440

South Dakota Geological Survey
Department of Water and Natural Resources
Science Center
University of South Dakota
Vermillion SD 57069
(605)677-5227

Tennessee Division of Geology
Department of Conservation
701 Broadway
Customs House
Nashville TN 37219-5237
(615)742-6691

Texas Bureau of Economic Geology
The University of Texas at Austin
University Station
Box X
Austin TX 78713
(512)471-1534 or471-7721

Utah Geological and Mineral Survey
Utah Department of Natural Resources
606 Black Hawk Way
Salt Lake City UT 84108-1280
(801)581-6831

Office of the State Geologist
Agency of Natural Resources
103 South Main Street
Center Building
Waterbury VT 05676
(802)244-5164

Division of Mineral Resources
Department of Mines, Minerals and Energy
Natural Resources Building
PO Box 3667
Charlottesville VA 22903

Division of Geology and Earth Resources
Department of Natural Resources
Olympia WA 98504
(206)459-6372

West Virginia Geological and Economic Survey
Mont Chateau Research Center
PO Box 879
Morgantown WV 26507-0879
(304)594-2331

Wisconsin Geological and Natural History Survey
University of Wisconsin-Extension
3817 Mineral Point Road
Madison WI 53705
(608)262-1705

The Geological Survey of Wyoming
Box 3008
University Station
Laramie WY 82071-3008
(307)721-3920 or 766-2286

APPENDIX D: GEOLOGICAL TIME SCALE

Approximate millions of years before present	ERA	PERIOD	EPOCH	Approximate duration (millions of years)	ANIMAL LIFE	PLANT LIFE
0.01	CENOZOIC	Quaternary	Recent (Holocene)	0.01	Modern humans.	Woody plants less common.
			Pleistocene	1.6	Ice Age. Evolution of humans. Rise and extinction of giant mammals. Horses become extinct in North America.	Extinction of many species.
1.6		Tertiary	Pliocene	3.7	Early human relatives.	Modern plants. Fewer forests.
5.3			Miocene	18.7	First true deer.	Grasslands spread.
24			Oligocene	13	First rhinoceroses.	Monocots common.
37			Eocene	21	First relatives of camels, horses, whales, elephants, cats, and dogs.	First grasses.
58			Paleocene	7	Many modern orders of mammals appear.	First monocots; dicots common.
65	MESOZOIC	Cretaceous		79	Appearance of first primates, snakes, and modern birds. Most groups of mammals still primitive. Extinction of dinosaurs, pterosaurs, large marine reptiles, and ammonites and many other invertebrates at end of Cretaceous.	Angiosperms spread. Gymnosperms decline.
144		Jurassic		64	Dinosaurs dominant. First birds, frogs, salamanders, and pterosaurs (flying reptiles).	First sequoias. Cycads and conifers common; angiosperms (plants with covered seeds) appear.
208		Triassic		37	First dinosaurs, ichthyosaurs (fish-like marine reptiles), turtles, crocodiles, and mammals. Reptiles start to dominate life on dry land. Giant amphibians become extinct.	Primitive seed ferns become extinct. Gymnosperms dominant.
245	PALEOZOIC	Permian		41	Abundant types of reptiles. First mammal-like reptiles. Major extinction event involving many invertebrates at end of Permian.	Lycopods, horsetails, seed ferns, and gymnosperms become less common.
286		Carboniferous * Pennsylvanian Mississippian		74	Amphibians dominate dry land. First reptiles and flying insects (some very large).	First forests. Coal swamps with horsetails and lycopods (primitive plants). First conifers and ginkgos (gymnosperms).
360		Devonian		48	The "Age of Fishes." Large fishes in seas. First ammonites (nautilus-like cephalopods) and sharks. First land vertebrates (amphibians).	First seed plants (gymnosperms, with naked seeds).
408		Silurian		30	First jawed fishes. Armored (jawless) fishes become abundant.	First known land plants.
438		Ordovician		67	First vertebrates (jawless fishes). Abundant invertebrates in seas.	No known land plants, but simple mosses and lichens may have lived on land.
505		Cambrian		65	Animals become abundant in the fossil record. All major groups (phyla) of animals present. First snails, clams, corals, and cephalopods (relatives of squid).	Great numbers of marine algae appear in the fossil record.
570	PRECAMBRIAN	Begins with origin of Earth 4.6 billion years ago.		4000	Mostly soft-bodied, worm-like animals that leave few traces in the fossil record. Primitive arthropods and mollusks.	Primitive plant-like bacteria (blue-green algae). Some build stromatolites (layered, dome-shaped mounds).

* Carboniferous is standard worldwide; in the U.S. the Mississippian and Pennsylvanian periods are often used instead.

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*Carboniferous is standard worldwide; in the U.S. the Mississippian and Pennsylvanian periods are often used instead.

The story of how a rabbit became a fossil

1. The living rabbit. Where an animal lives is important in determining its chances of becoming a fossil after it dies. An animal that lives next to the water like this rabbit will have a much better chance of fossilization than one that lives far from water.

2. The rabbit dies.

3. The dead rabbit (carcass) is swept into the water by a flood. It lies on the bottom and begins to decay.

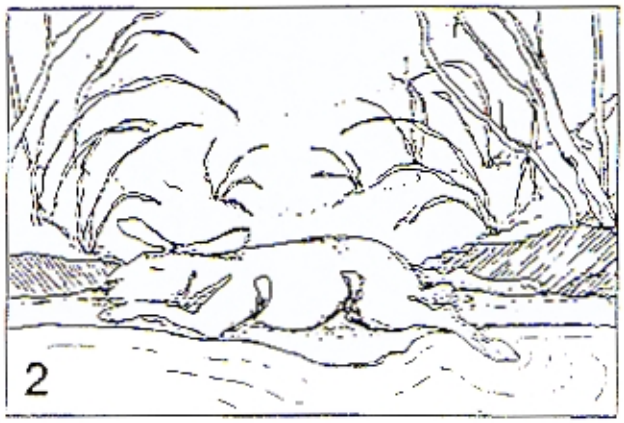
4. The soft parts decay away. Normally, bones and flesh become a source of food for scavengers. For an animal to become a fossil, something must happen so scavengers are excluded. This could happen if :there is not enough oxygen in the water to breathe or if the dead animal is buried quickly.

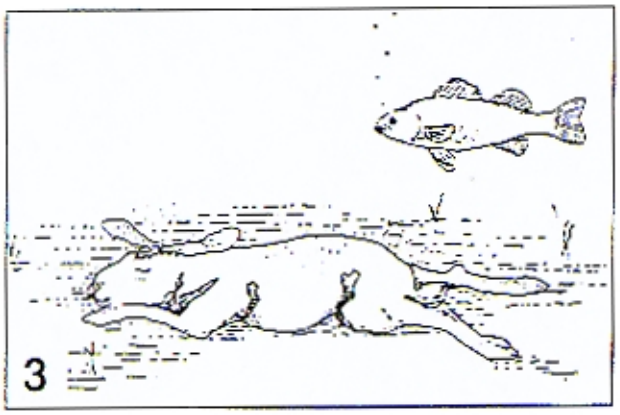
5. The skeleton is buried in sediment.

6. The sediments build up to great thickness. They are squeezed together by the weight of the sediments on top of them. After a long time they turn to sedimentary rock.

7. The sedimentary rocks are uplifted and slightly tilted by geological forces. Erosion cuts through the stack of rocks, exposing the fossil.


1


2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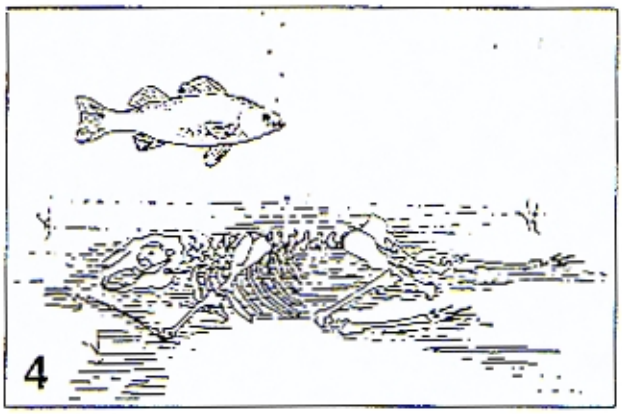
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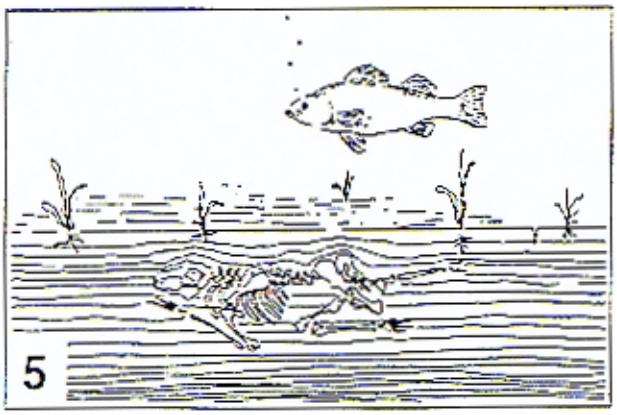
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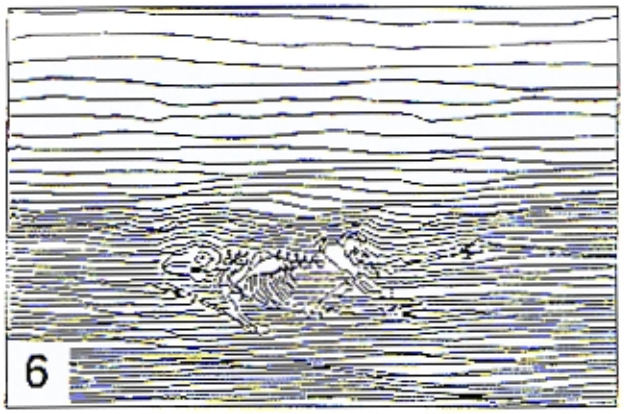
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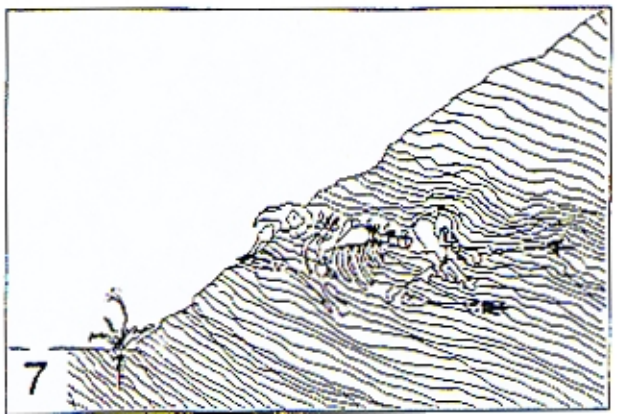

7

UNIT ONE: FOSSILIZATION

Pre-Questions

1. What is a fossil?

2. How does an animal or plant become a fossil?

3. Your footprints on the beach are evidence that you were there. Do you think you could call your footprints trace fossils? Why or why not? If they were still there after 20,000 years, could you call them fossils then?

UNIT ONE: FOSSILIZATION

Post-questions

1. What are some ways that an animal or plant could become a fossil? (Name as many different ways as you can think of?

2. What three things are required for a living thing to become a fossil?

3. Why is it normally so hard for a plant or animal to become a fossil after it dies?

4. What is the difference between a "normal" fossil (body fossil) and a trace fossil?

4. Why are fossils important? What do they tell us?

5. The hard parts of a living thing may be preserved for millions of years in rock. This is:very important evidence that cannot be replaced, like the evidence a detective finds at the scene of a crime. It tells us how living things were different in the past. What can you do to protect this evidence?

7. Name some national parks or monuments or sites on public lands that have fossils. What kind of fossils are they?

UNIT TWO: ADAPTATION

Pre-Questions

1. What is an environment?

2. What is your environment like?

3. What kinds of animals and plants live with you in your environment?

4. What is a fossil?

5. What can we learn from studying fossils?

UNIT TWO: ADAPTATION

Post-Questions

1. What are the two parts of an environment?

2. How are fossils important to us?

3. What kind of animals and plants lived in the past at the national park, monument, or area that you visited? What do these fossils tell us about the environment at that time? Has the environment changed? How is it different?

4. How are the fossil animals and plants of the place you visited different from the ones living today in that same area?

5. Could you find places where the environment today is similar to the ancient environment at your field trip site? Where?

6. How do we know what ancient animals were like?

7. What happens to an animal or plant when the environment changes?

8. What are some ways that animals or plants can become extinct?

9. List some animals that are extinct. How many of these have gone extinct recently?

10. What are some things that humans do to the environment that might be bad for living things (including us)?

UNIT THREE: COMMUNITY

Pre-questions

1. Where does your food come from?

2. How can a paleontologist learn about the community of plants and animals living at times in the past?

UNIT THREE: COMMUNITY

Post-questions

1. Think about the fossils of the place you visited on your field trip that lived together. Which ones are predators? Which are the prey? Are there some that you cannot tell?

2. Make a food chain for the fossil animals and plants you are studying.

3. With the help of your classmates, construct a food web for the animals and plants that lived at the time of the fossils you studied on the field trip.

4. How does a predator species depend on its prey?

5. How does a prey species depend on predators?

5. Where does your food come from? (Hint: think of the food chain. Vegetables and grains you eat come directly from green plants that get their food from sunlight. Meat you eat comes from animals that eat green plants?

6. How healthy would an ecosystem be if many of its parts are missing? For example, what if there are very few predators?

8. Can you think of an example of an unhealthy ecosystem?

UNIT FOUR: HUMAN INFLUENCES

Pre-questions

1. When is it good to collect a fossil?

2. Are there times when it would be best not to collect a fossil? When?

3. What does a paleontologist do?

4. Is paleontology important to you? Why or why not?

5. Would you like to be a paleontologist? Why or why not?

UNIT FOUR: HUMAN INFLUENCES

Post-questions

1. Pretend you are a paleontologist. What would you do to make paleontology interesting for people who come to visit your museum?

2. What is something bad that you might do as a paleontologist that would make it hard for other paleontologists to learn about the fossils you find?

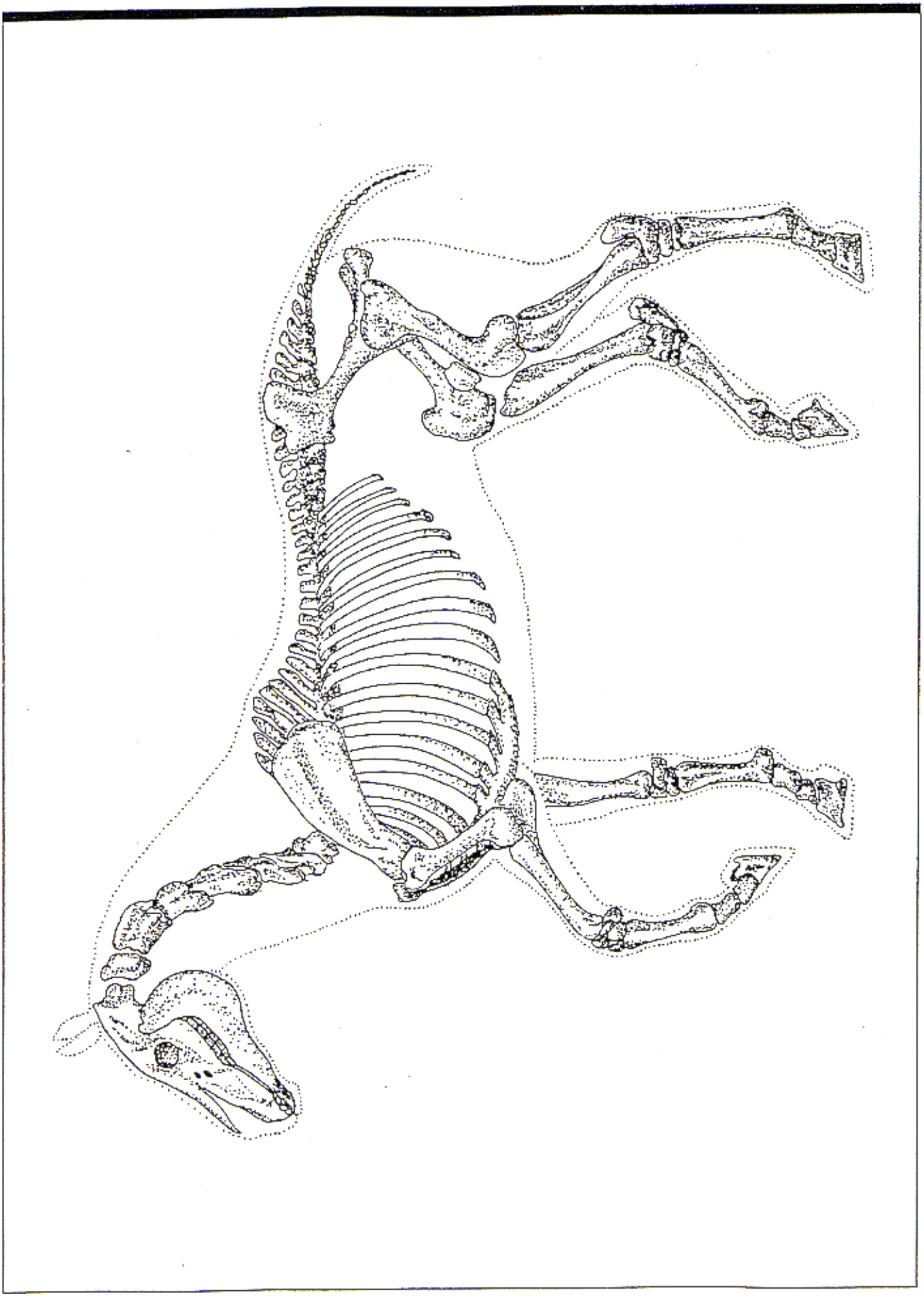
3. What kind of fossils did you like learning about most?

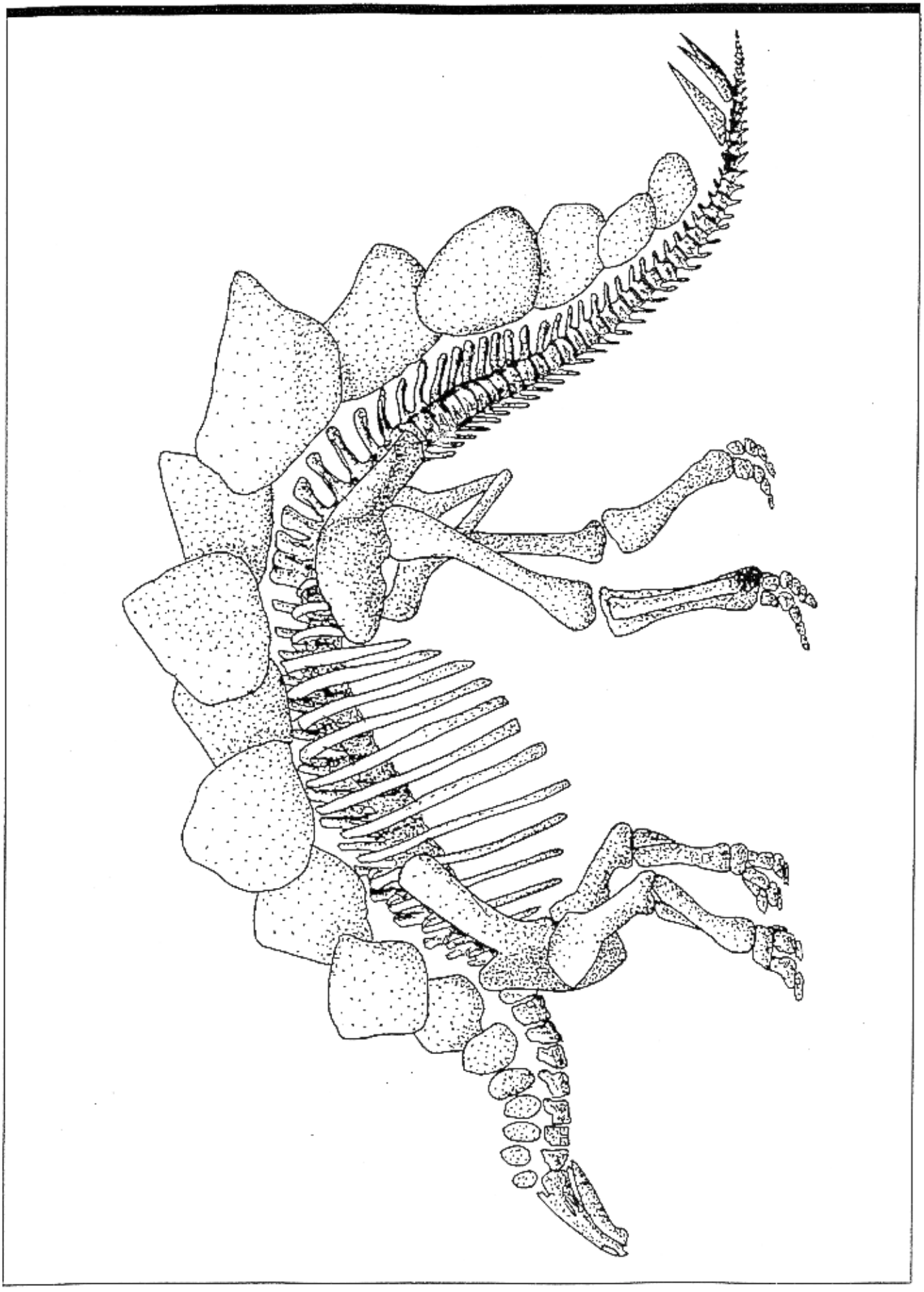
4. Is there something about the science of paleontology that would make you want to become a paleontologist? What is it?

5. Do you think that paleontology is a useful thing to do, or would we be better off if paleontologists did something else like fix cars?

6. What would be the best thing to do if you found a rare fossil while hiking in the hills?

DRY UP	DRY UP
ROT AWAY	ROT AWAY
ROT AWAY	SWALLOWED BY ALLIGATOR
SWALLOWED BY CROCODILE	SWALLOWED BY CROCODILE
SWALLOWED BY BIG FISH	SWALLOWED BY BIG FISH
EATEN BY SCAVENGERS	EATEN BY SCAVENGERS
BURIED IN SOFT MUD— YOU BECOME A FOSSIL!	BURIED IN MUDSLIDE— YOU BECOME A FOSSIL!
WASHED AWAY BY WAVES	WASHED AWAY BY WAVES
WASHED AWAY BY CURRENT	WASHED AWAY BY CURRENT





Stratigraphy

The stratigraphic section on the next page is an actual section from the Green River Formation on public lands near Fossil Butte National Monument in Wyoming. It shows 11 meters of sedimentary rock and the fossils that were collected from them. The different patterns are symbols for different kinds of rocks (see key below). The legend at the bottom of the section explains the symbols for fossils. These symbols are drawn next to the level at which they were found. In several cases, more than one kind of fossil is found in the same layer.

Plotting the stratigraphic position (level) of fossils makes it easy to judge the relative age of different sets of fossils. By plotting fossils and rock types together, paleontologists can see if certain fossils frequently occur in the same type of rock. By comparing stratigraphic sections from different areas, scientists can study regional conditions and how they changed through time. This is how the story of life in the past is put together.

This stratigraphic section could be used as an exercise in addition and subtraction (it is a kind of rJmber line). The questions on the handout are intended to help children understand why paleontologists are interested in the stratigraphic position of fossils they collect. Remember, rocks and fossils that formed first (the oldest) are at the *bottom* of the section; younger rocks and fossils lie above.

Answers to questions on the handout page

1. The youngest fish is the one nearest the top of the diagram. It is located about 8 meters from the bottom. Other fossils found with this fish are coprolites and plant parts.

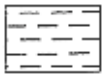
2. The oldest clam (the one nearest the bottom) was found a little over 2 meters from the bottom of the section. The youngest clam was found 11 meters from the bottom. The difference (11-2) is 9 meters.

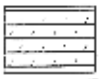
3. Coprolites were found at eight different levels.

4. Coprolites were found with leaves, clams, fish, plant parts, and insects. A good guess about where the coprolites came from would be fish. Insects, clams, or shrimp could be other answers. The students could also guess a number of different animals (especially if they are familiar with the fossils of Fossil Butte National Monument), but there is no evidence from this particular section that any other animal was there.

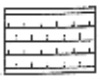
Key to rock symbols


Very thin limestone layers

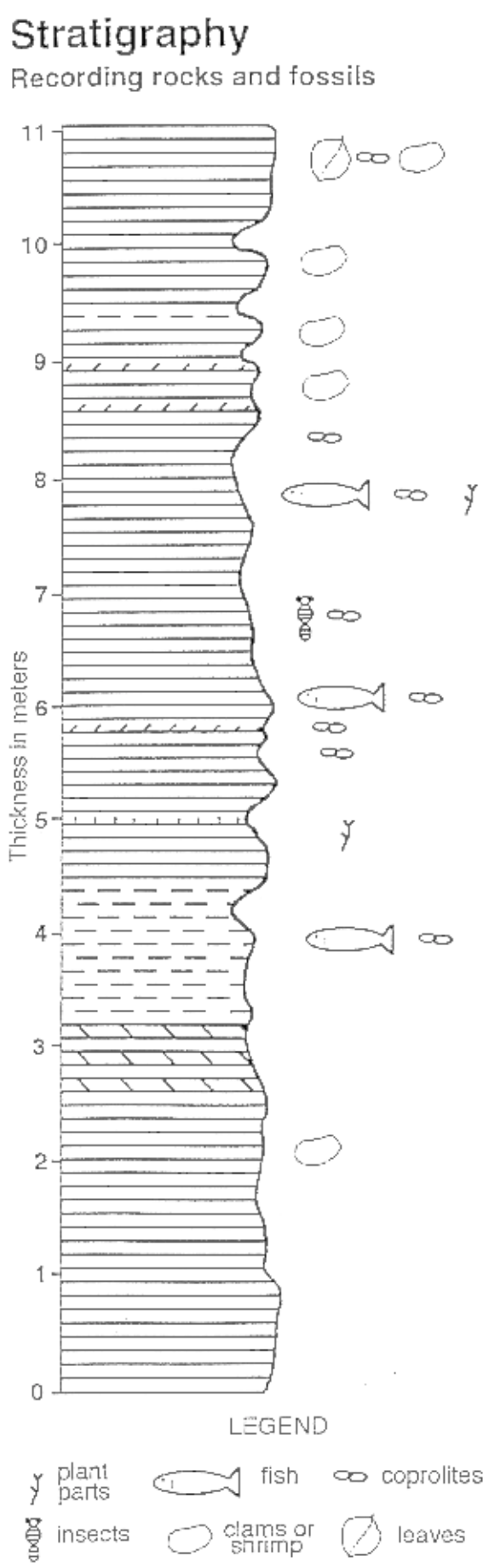

Thin, silica-rich rocks with no carbonate minerals


Dolomitic siliceous rocks


Calcareous siliceous rocks


Aragonitic rocks

Section redrawn from Buchheim, *H. P., Paleolimnology of the Laney Member of the Eocene Green River Formation,* Ph.D. Dissertation, University of Wyoming, 1978.



Questions

1. How many meters high in the section is the youngest fish? What other kinds of fossils were found with this fish?

2. How many meters above the oldest clam was the youngest clam found?

3. At how many different levels were coprolites found?

4.With what other kinds of fossils were coprolites found? What animals would you guess these coprolites could be from?

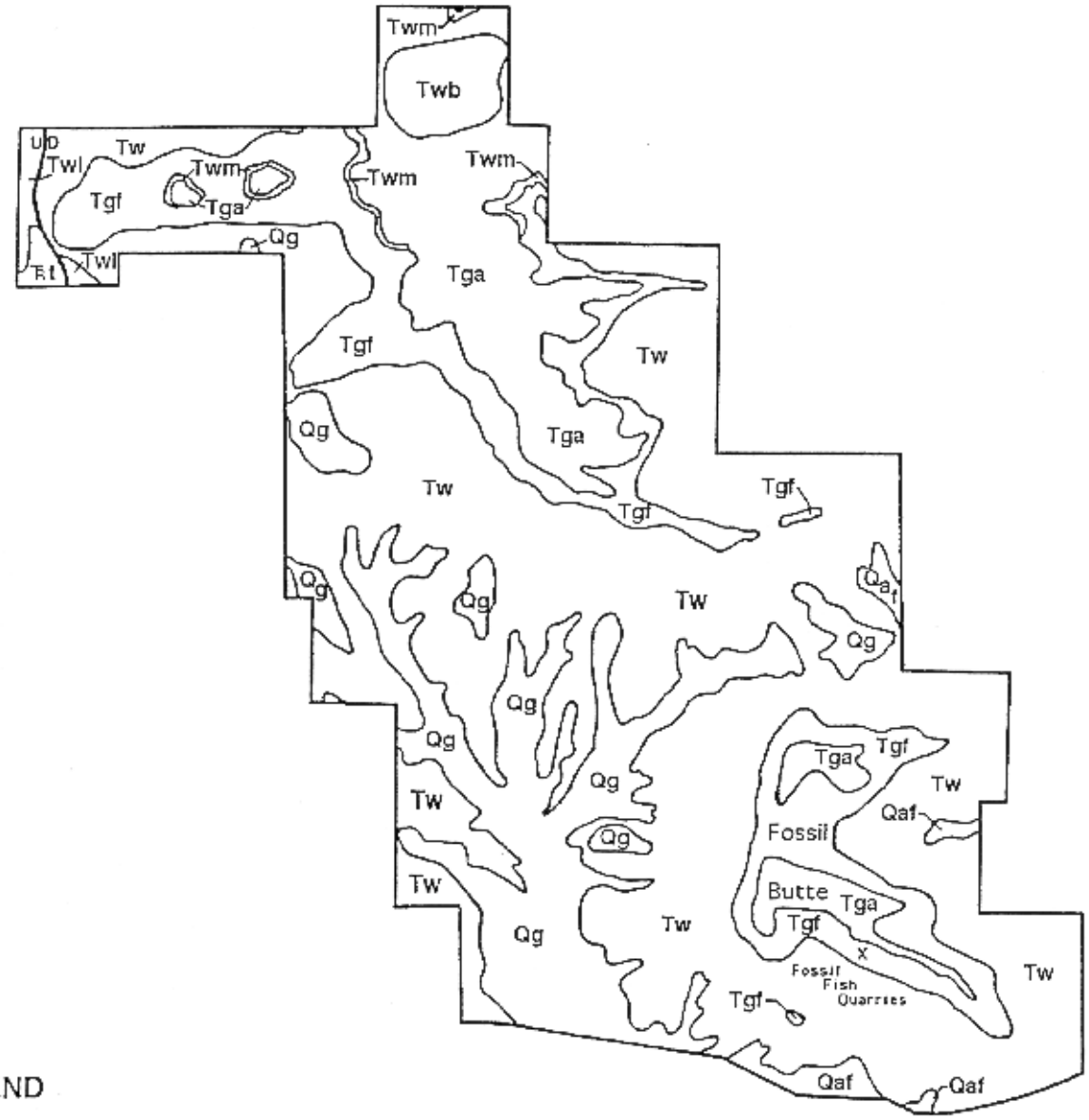
Geologic Map

On the following page is a geologic map of the area around Fossil Butte National Monument in Wyoming. Geologic maps show the formations (rock layers) and *members (parts* of formations) that are exposed at the surface. Each formation or member is given a different color or pattern on the map to make it stand out from the others.

The map in this handout has not been colored, but each of the formations is labeled with an abbreviated name. These abbreviations are explained in the legend below the map. The rock names in the legend are arranged stratigraphicafiy, that is, with the oldest rocks on the bottom and progressively younger rocks as you go up. Rocks represented on this map are from the Triassic Period, the Eocene Epoch of the Tertiary Period, and the Quaternary Period.

The object of this exercise is to color each of the rock layers on the map a different color. Use similar colors for the members of each formation. For example, you might color the four members of the Wasatch Formation red, pink, reddish-orange, and orange. When you are done, you will have a real geologic map.

Geologic Map of Fossil Butte National Monument



LEGEND

Age	Symbol	Color	Name of formation or member
Quaternary	Qg - Qaf		Gravel and stream deposits
Eocene	Tga		Angelo member of Green River Formation
	Tgf		Fossil Butte member of Green River Formation
	Twb		Bullpen member of Wasatch Formation
	Twm		Mudstone member of Wasatch Formation
	Tw		Main body of Wasatch Formation
	Twl		Lower member of Wasatch Formation
Triassic	Rt		Thaynes Limestone (only in northwestern corner)

PALEONTOLOGY MUSEUM

Specimen card

Specimen number _____

Name of fossil _____

_____

Locality _____

Identified by _____

Collector _____

Date collected _____

PALEONTOLOGY MUSEUM

Specimen card

Specimen number _____

Name of fossil _____

_____

Locality _____

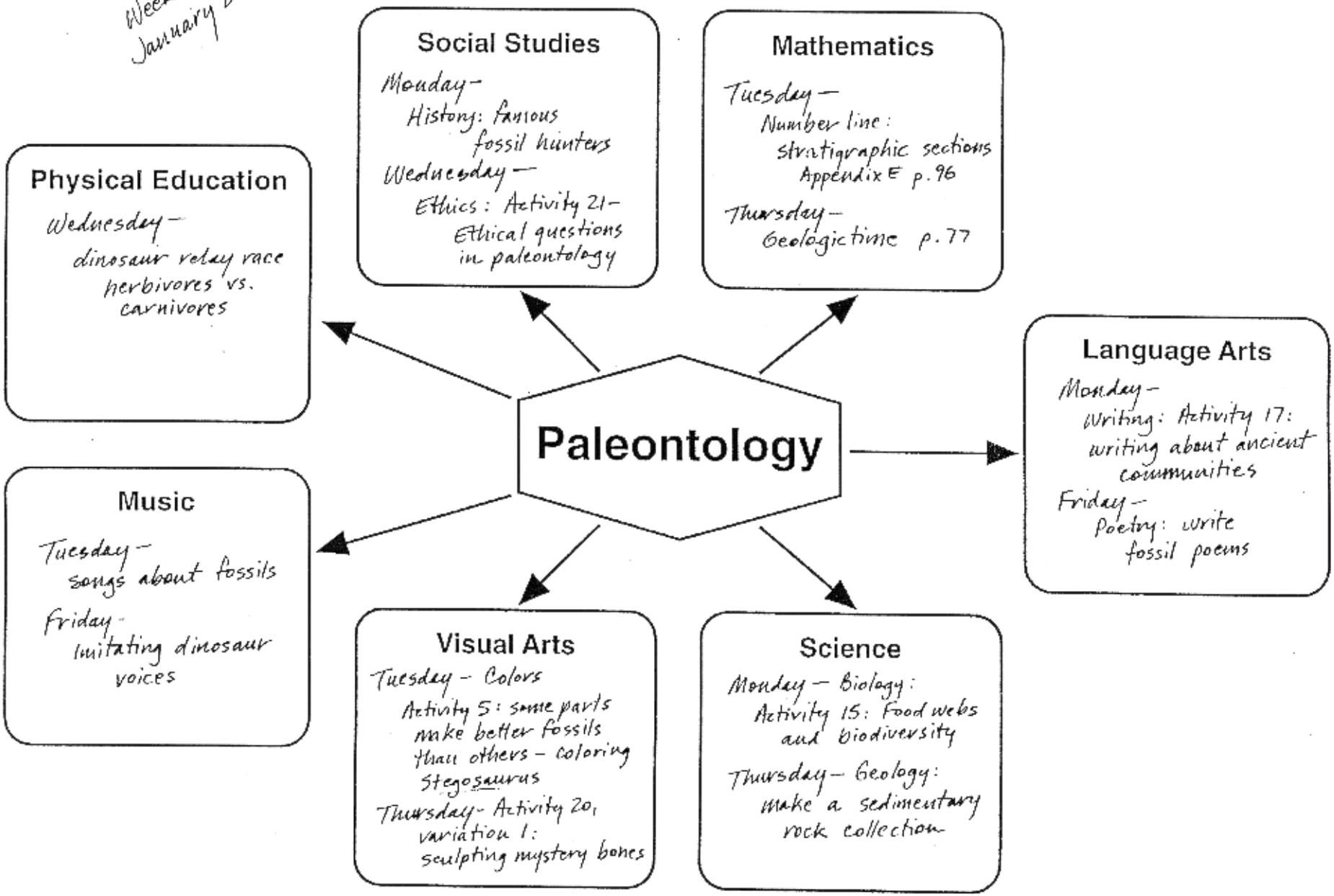
Identified by _____

Collector _____

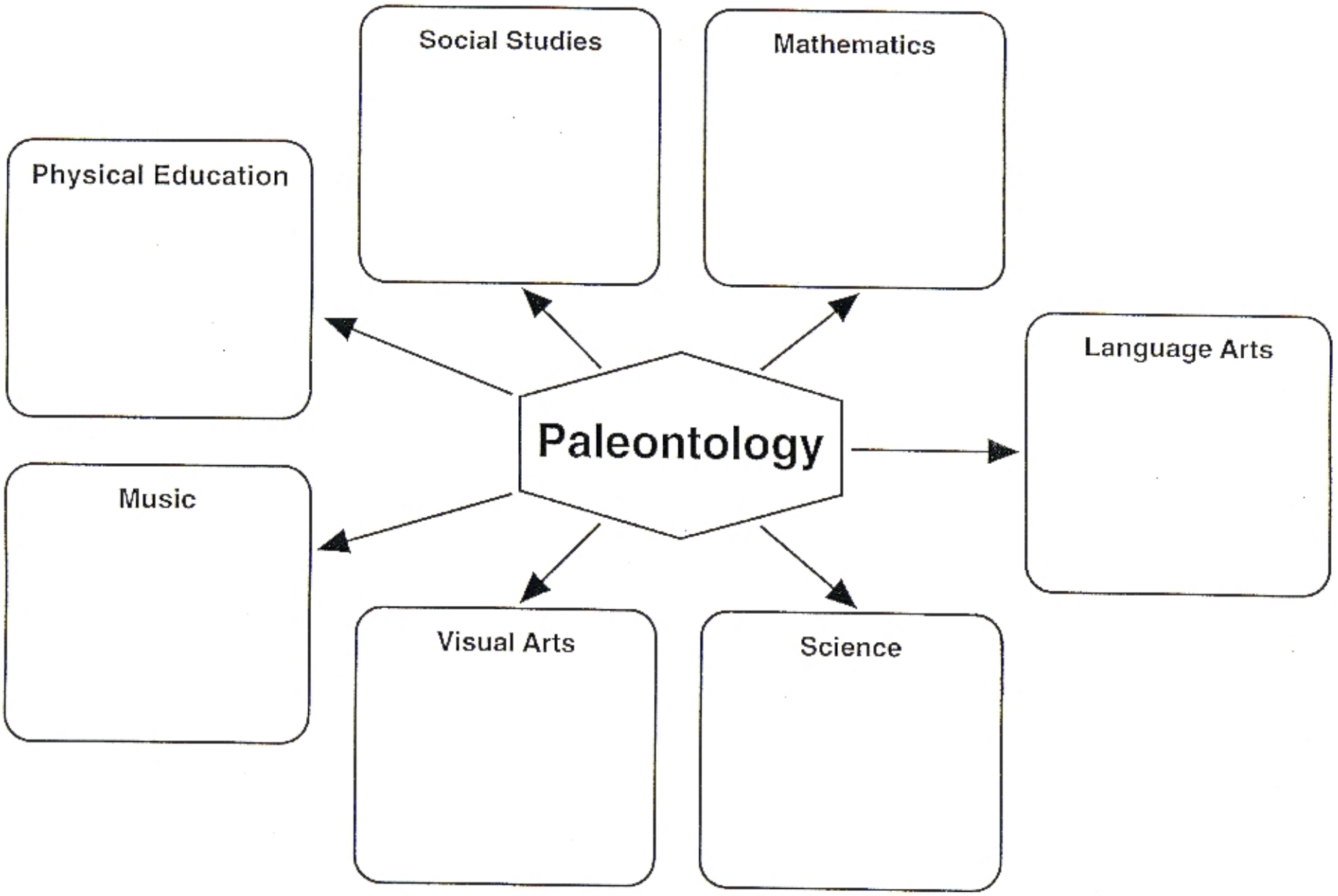
Date collected _____

Classroom Planning Chart (sample)

Week of January 21st



Classroom Planning Chart



APPENDIX F:
SOURCES FOR CLASSROOM FOSSIL CASTS

Dino Productions
P.O. Box 3004
Englewood, CO 80155

Dinosaur Nature Association
1291 E. Highway 40
Vernal, UT 84078

Geo Science Industries
4015 S. Taft Hill Rd.
Fort Collins, CO 80526

Geoscience Resources
2990 Anthony Rd.
Burlington, NC 27215

Jones Fossil Farm
East Acres Park
Worthington, MN 56187

Saurus
530 S. 4th East
Centerville, UT 84104

Ward's Natural Science Establishment, Inc.
5100 West Henrietta Rd.
P.O. Box 92912
Rochester, NY 14692-9012

GROWING SECTION

The following pages contain ideas on classroom paleontology that were contributed by previous users of the teaching guide. This section will grow as the guide is used. We hope these ideas are useful in your teaching of paleontology.

If you have some ideas generated by your classroom experiences, we would be glad to include them in the guide. Fossil Butte National Monument is the collecting point for teacher contributions. Send your ideas to:

Fossil Butte National Monument
Environmental Education Program
PO Box 592
Kemmerer WY 83101-0592

Learning to Prepare a Fossil

Message	From the study of fossils and how they were formed, we can learn a great deal about the animals and plants of the distant past.
Materials	8" x 10" fish cast dissecting needle plaster--1 tablespoon. Mixed with water specimen cards (Appendix E Page 99) optional: large magnifying lens goggles

Prepare plastic fish by covering it with a thin layer of plaster (approximately 1 /8"). The plaster simulates matrix (limestone) which has to be removed in order to'study the specimen. Allow to dry.

Procedure

The delicate task of cleaning and working on a specimen is best done on a stout table with good light and adequate tools. To obtain maximum detail, scientists do much preparation under a microscope. Using a magnifying lens will help. Keeping preparation tools sharp eliminates the need to apply too much pressure which can damage the fossil.

1. With the dissecting tool, very carefully scratch the plaster off the fossil fish using short, gentle, even strokes. If you scratch too hard, the fossil may be damaged. Watch for a dark color to appear.

2. Blow away the loosened matrix (plaster) from the fossil as you go. By alternately scratching and blowing, the fine detail of the specimen can be exposed.

3. When you see a dark color appear, you have reached the fossil. If you continue to scratch, you may destroy the fossil. Move to an area nearby that has not been cleaned and continue preparing using short, gentle, even strokes.

4. When all of the fossil fish has been exposed, you are ready to identify it using the pictures below.

5. Record the information revealed on a specimen card.

Teacher Evaluation Form

Your comments on this form will help us improve future editions of the teaching guide. You may use additional pages for any other comments or suggestions. Please return the completed form with the kit. Thank you.

Teacher's name _____

School _____ Grade level _____

Which units did you use?

☐ Unit 1 ☐ Unit 2 ☐ Unit 3 ☐ Unit 4

Did the Overview sections cover the material clearly?

Were the questions appropriate for the students' level and the material covered?

Which of the exercises did you find most helpful in teaching? Which were least helpful?

Was the computer simulation (Unit 3) useful in your classroom?

Which version did you use?

☐ IBM ☐ Apple

Did you or the students experience any problems with the software? Explain.

What materials did you use from the kit?

What, if any, other materials should be included in the kit?

Comment on the quality and appropriateness of the fossil casts.

Additional comments (use other sheets if necessary):